

EXECUTIVE SUMMARY

Thank you for your continued hard work sampling **Cobbetts Pond** this year! We congratulate your group for sampling your pond **once** this summer (additional data supplied by Geosyntec, engineers hired to conduct a watershed management plan). However, we ***strongly encourage*** your monitoring group to sample additional times each summer. Typically, we recommend that monitoring groups sample **three times** per summer (once in **June, July, and August**). We understand that the number of sampling events you decide to conduct per summer will depend upon volunteer availability, and your monitoring group's goals and funding availability. However, with a limited amount of data it is difficult to determine accurate and representative water quality trends. Since weather patterns and activity in the watershed can change throughout the summer, from year to year, and even from hour to hour during a rain event, it is a good idea to sample the pond at least once per month during the summer.

Also, with consideration to the I93 construction at Exit 3, and the spring discharges of waste into Cobbetts Pond, it is most important to follow through with a more vigorous sampling schedule for the 2010 season. As a result of these discharges, it will be important to track water quality trends to measure and document potential water quality impairments to the pond.

If you are having difficulty finding volunteers to help sample or to travel to one of the laboratories, please call the VLAP Coordinator and DES will help you work out an arrangement.

Thank you for joining the DES Weed Watchers Program! A Weed Watcher training was conducted at **Cobbetts Pond** during **2009**. Volunteers were trained to survey the pond once a month from **May** through **September**. To survey, volunteers slowly boat, or even snorkel, around the perimeter of the pond and any islands it may contain. Using the materials provided in the Weed Watcher kit, volunteers look for any species that are suspicious. After a trip or two around the pond, volunteers will have a good knowledge of its plant community and will immediately notice even the most subtle changes. If a suspicious plant is found, the volunteers immediately send a specimen to DES for identification. Cobbetts Pond currently has a Variable milfoil infestation, and a long-term management plan has been formulated by DES. Remember that early detection is the key to controlling the spread of exotic plants.

Watershed Management Plan

The Cobbetts Pond watershed is heavily developed, lies entirely within the Town of Windham and includes 14 sub-watersheds. The pond itself is completely surrounded by residential roads with a second tier of transportation corridors including Route 111, Route 111A, Cobbetts Pond Road and I-93. Since the 1980s, the Pond's water quality has shifted rapidly from Oligotrophic to Eutrophic due to cultural eutrophication. As a result of the trophic shift,

Cobbetts Pond is listed as impaired for dissolved oxygen saturation, which causes a failure to support the aquatic life use designation.

In 2008, the Cobbetts Pond Improvement Association applied to DES for EPA Section 319 restoration grant funding to develop a watershed management plan to address pollutant loads causing the water quality impairment. The CPIA was awarded \$83,000 to collect additional water quality data and develop the watershed management plan. Additional water quality data collection occurred in 2009. DES and the CPIA anticipate watershed improvement projects will begin in 2010 or 2011.

I-93, Rte 111, Rte 111A Construction, Windham

Following severe water quality violations related to I-93, Exit 3 construction in December, 2009, DES, DOT and the CPIA developed a working group partnership. The work group has met weekly with DOT's contractors and erosion control consultants. The workgroup's objectives are to communicate current and future conditions related to the construction project and discuss methods to improve erosion and sediment control to protect surface water quality including Cobbetts Pond with its tributaries and wetlands.

Weekly site inspections and close monitoring of weather forecasts and actual precipitation events resulting in stormwater runoff are also critical in preventing sediment from discharging to surface waters. To verify that erosion and sediment control measures are working, the erosion control consultant is required by DES to collect water quality samples during rain events of greater than 0.5 inches in 24 hours. With assistance from the DES Air Quality Division and DES Information Technology an automated email and text messaging notification system has been developed which notifies all parties when rainfall conditions occur, triggering a site inspection and rain event monitoring.

DOT has made erosion and sediment control a priority for their road construction projects. DOT's contract administrators and environmental inspectors have been instrumental in providing the resources necessary to protect surface water quality.

OBSERVATIONS & RECOMMENDATIONS

DEEP SPOT

➤ **Chlorophyll-a**

Chlorophyll-a, a pigment found in plants, is an indicator of algal or cyanobacteria abundance. Algae are typically microscopic plants that are naturally found in the lake ecosystem. The measurement of chlorophyll-a in the water gives biologists an estimation of the algal concentration or lake productivity. Table 14 in Appendix A lists the current year chlorophyll-a data.

Figure 1 depicts the historical and current year chlorophyll-a concentration in the water column.

The median summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 4.58 mg/m³.

STATION 1

The current year data (the top graph) show that the chlorophyll-a concentration **increased** from **April** to **May**, **decreased** from **May** to **June**, **increased** from **June** to **August**, and then **decreased** from **August** to **October**.

The historical data (the bottom graph) show that the **2009** chlorophyll-a mean is **greater than** the state and similar lake medians. For more information on the similar lake median, refer to Appendix D.

Overall, visual inspection of the historical data trend line (the bottom graph) shows an **increasing** in-lake chlorophyll-a trend since monitoring began. Specifically the mean chlorophyll concentration has **worsened** since **1988**.

STATION 2

The current year data (the top graph) show that the chlorophyll-a concentration **decreased** from **May** to **June**, **increased** from **June** to **August**, **decreased** from **August** to **September**, and then **increased** from **September** to **October**.

The historical data (the bottom graph) show that the **2009** chlorophyll-a mean is **greater than** the state and similar lake medians. For more information on the similar lake median, refer to Appendix D.

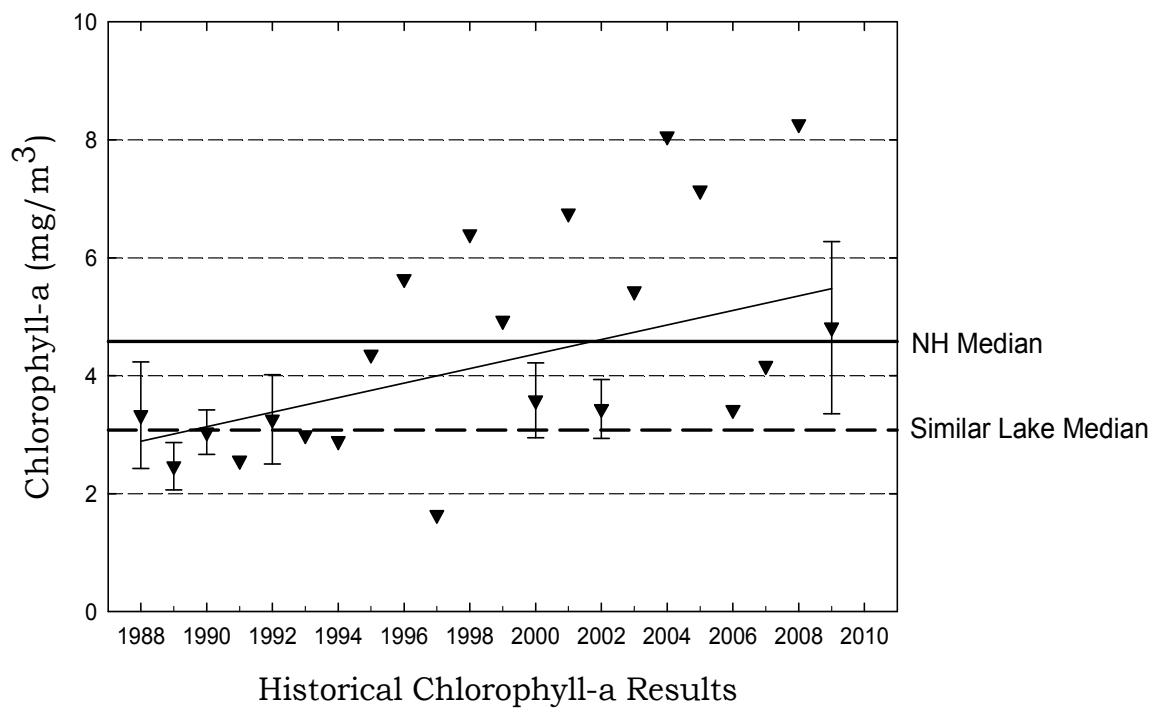
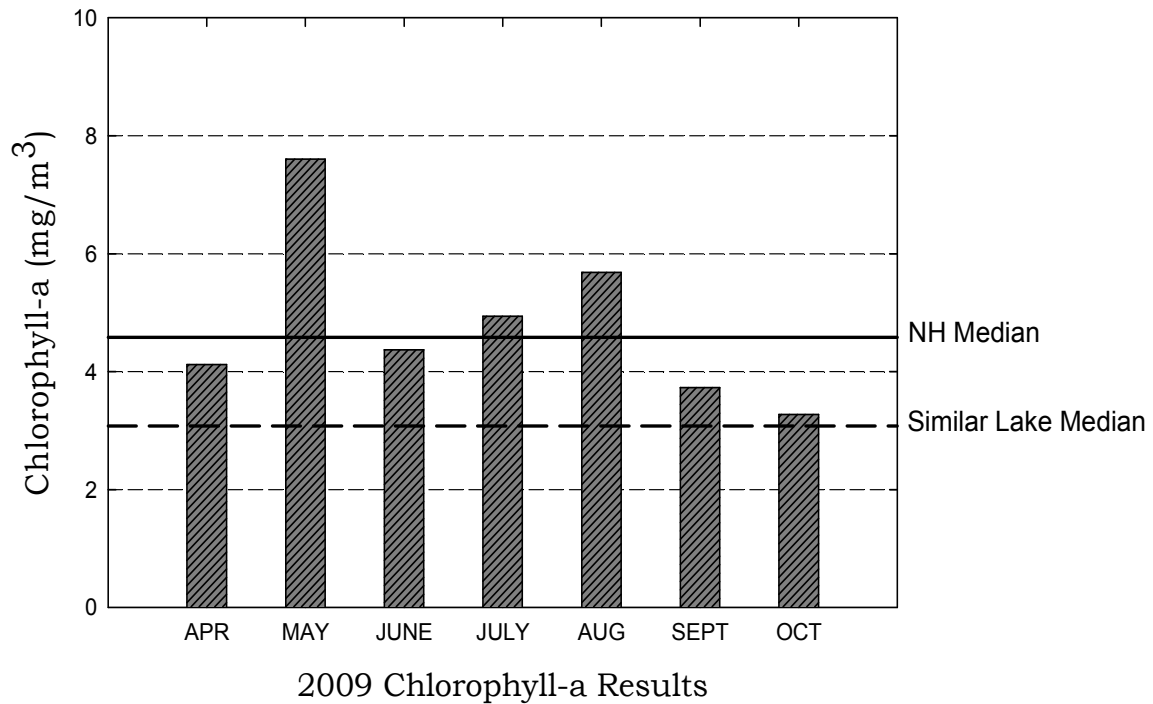
Overall, visual inspection of the historical data trend line (the bottom graph) shows an **increasing** in-lake chlorophyll-a trend since monitoring began. Specifically the mean chlorophyll concentration has **worsened** since **1988**.

While algae are naturally present in all waterbodies, an excessive or increasing amount of any type is not welcomed. Phosphorus is the nutrient that algae typically depend upon for growth in New Hampshire lakes and ponds. Algal concentrations increase as nonpoint sources of phosphorus from the watershed increase, or as in-lake phosphorus sources increase. Increased Chlorophyll-a concentrations can also affect water clarity, causing Secchi-disk transparency to decrease (worsen) and turbidity to increase (worsen).

Therefore, it is extremely important for volunteer monitors to continually educate all watershed residents about management practices that can be implemented to minimize phosphorus loading to surface waters.

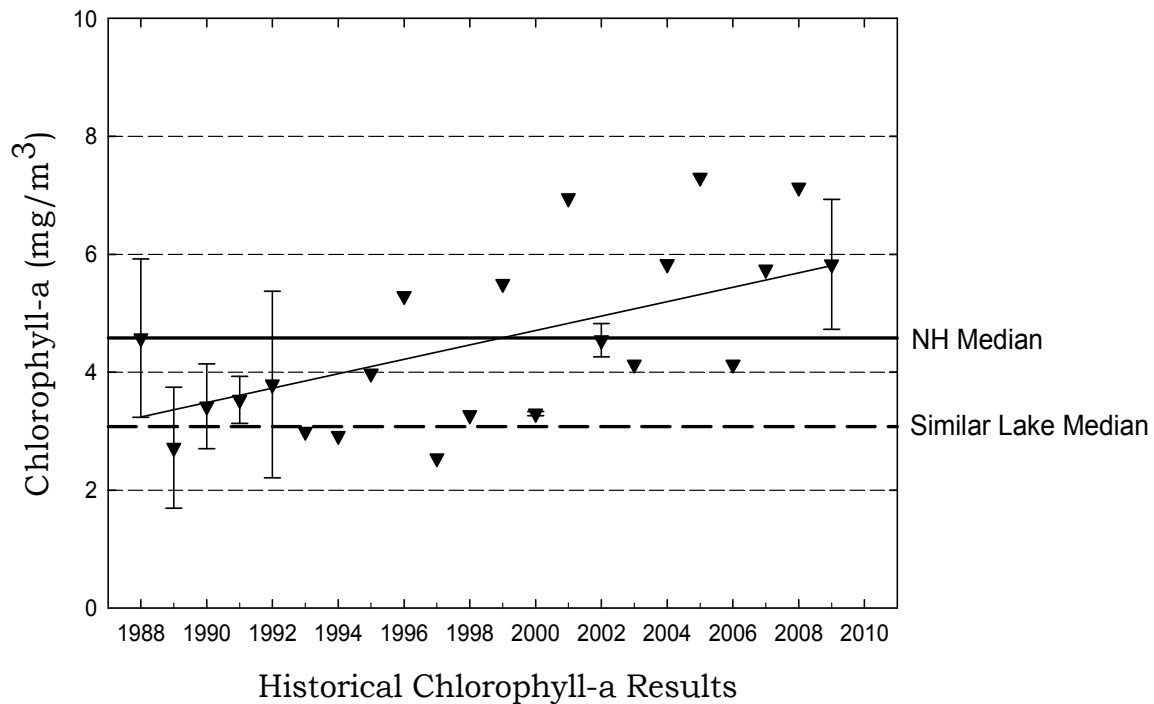
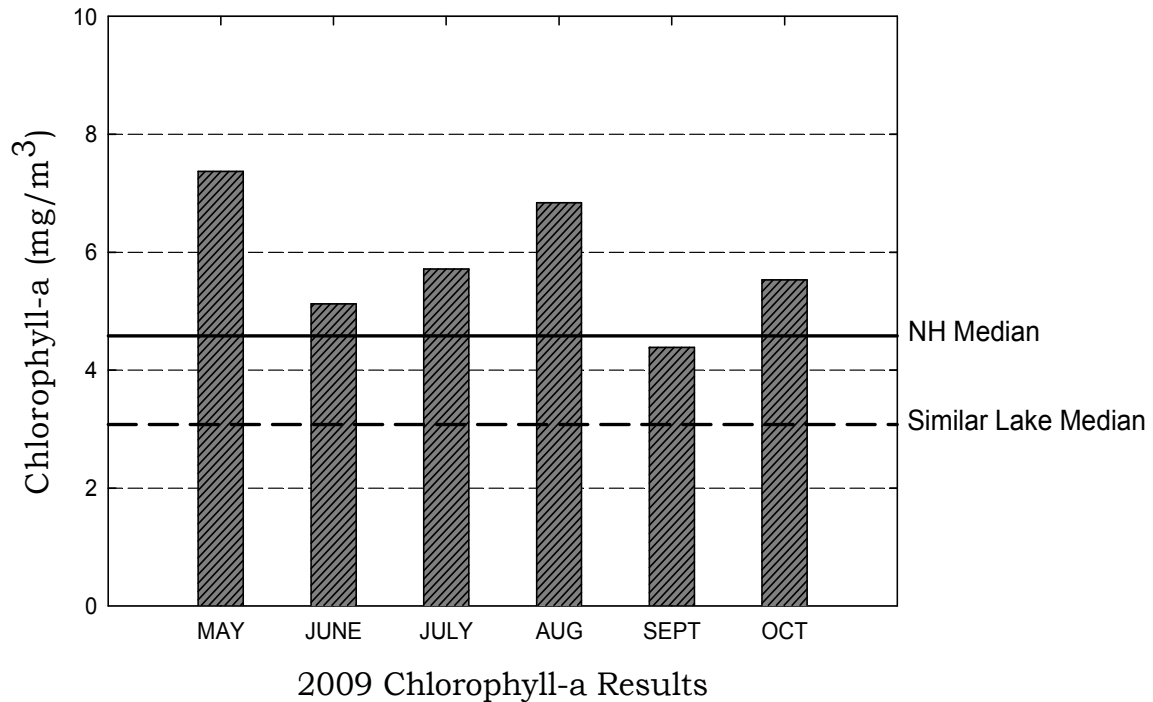
Cobbetts Pond, Stn. 1, Windham

Figure 1. Monthly and Historical Chlorophyll-a Results



Cobbetts Pond, Stn. 2, Windham

Figure 1. Monthly and Historical Chlorophyll-a Results



➤ **Phytoplankton and Cyanobacteria**

Tables 1 and 2 list the phytoplankton (algae) and/or cyanobacteria observed in the pond in **2009**. These data include phytoplankton samples collected for both VLAP and Geosyntec projects. Specifically, this table lists the three most dominant phytoplankton and/or cyanobacteria observed and their relative dominance in the samples.

Table 1. Dominant Phytoplankton/Cyanobacteria (South Station)

Date	Division	Genus	% Dominance
5/21/2009	Chrysophyta	Dinobryon	46.1
5/21/2009	Bacillariophyta	Synedra	32.3
5/21/2009	Bacillariophyta	Rhizosolenia	6.8
6/25/2009	Bacillariophyta	Rhizosolenia	51.6
6/25/2009	Bacillariophyta	Tabellaria	24.2
6/25/2009	Bacillariophyta	Synedra	18.3
7/2/2009	Bacillariophyta	Asterionella	75.4
7/2/2009	Bacillariophyta	Tabellaria	23.0
7/27/2009	Chrysophyta	Dinobryon	39.6
7/27/2009	Bacillariophyta	Tabellaria	37.2
7/27/2009	Bacillariophyta	Synedra	9.7
8/20/2009	Chrysophyta	Dinobryon	42.3
8/20/2009	Pyrrophyta	Ceratium	29.8
8/20/2009	Bacillariophyta	Tabellaria	21.1
9/17/2009	Pyrrophyta	Ceratium	40.5
9/17/2009	Chrysophyta	Dinobryon	18.3
9/17/2009	Bacillariophyta	Tabellaria	15.2
10/23/2009	Chrysophyta	Dinobryon	81.5
10/23/2009	Cyanobacteria	Anabaena	4.3
10/23/2009	Cyanobacteria	Oscillatoria	4.3

Table 2. Dominant Phytoplankton/Cyanobacteria (North Station)

Date	Division	Genus	% Dominance
5/21/2009	Chrysophyta	Dinobryon	40.2
5/21/2009	Bacillariophyta	Synedra	34.0
5/21/2009	Bacillariophyta	Tabellaria	13.4
6/25/2009	Bacillariophyta	Rhizosolenia	58.0
6/25/2009	Bacillariophyta	Synedra	27.1
6/25/2009	Bacillariophyta	Tabellaria	9.3
7/2/2009	Bacillariophyta	Asterionella	66.4
7/2/2009	Bacillariophyta	Tabellaria	16.8
7/2/2009	Bacillariophyta	Rhizosolenia	10.9
7/27/2009	Chrysophyta	Dinobryon	39.3
7/27/2009	Bacillariophyta	Tabellaria	28.0
7/27/2009	Cyanobacteria	Oscillatoria	8.7
8/20/2009	Pyrrophyta	Ceratium	44.7
8/20/2009	Bacillariophyta	Tabellaria	19.9
8/20/2009	Cyanophyta	Anabaena	12.1
9/17/2009	Pyrrophyta	Ceratium	30.4
9/17/2009	Bacillariophyta	Tabellaria	26.8
9/17/2009	Bacillariophyta	Synedra	7.2
10/23/2009	Chrysophyta	Dinobryon	60.0
10/23/2009	Bacillariophyta	Asterionella	13.0
10/23/2009	Bacillariophyta	Synedra	9.0

Phytoplankton populations undergo a natural succession during the growing season. Please refer to the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding seasonal plankton succession. Diatoms and golden-brown algae populations are typical in New Hampshire’s less productive lakes and ponds.

The cyanobacteria ***Anabaena* and *Oscillatoria*** were observed in various amounts in the plankton samples throughout the season. ***These cyanobacteria, if present in large amounts, can be toxic to livestock, wildlife, pets, and humans.*** Please refer to the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding cyanobacteria.

Also, a cyanobacteria bloom occurred in the pond in **August**. Samples were collected and returned to the DES Limnology Center for analysis. A **beach advisory** was issued on **8/12/2009** and a **lake warning** was issued on **8/14/2009** notifying the public of the presence of potentially toxic

cyanobacteria. The cyanobacteria were identified as **Anabaena** and **Microcystis**, both potentially toxic cyanobacteria. Samples were collected regularly throughout the advisory period. The beach advisory was removed on **8/18/2009** after cyanobacteria concentrations decreased to acceptable levels at the public beach. The lake warning was removed on **8/27/2009** after no visible cyanobacteria surface scums were present.

Cyanobacteria can reach nuisance levels when phosphorus loading from the watershed to surface waters is increased and favorable environmental conditions occur, such as a period of sunny, warm weather.

The presence of cyanobacteria serves as a reminder of the pond's delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading to the pond by eliminating fertilizer use on lawns, keeping the pond shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

In addition, residents should also observe the pond in September and October during the time of fall turnover (lake mixing) to document any algal blooms that may occur. Cyanobacteria have the ability to regulate their depth in the water column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to "pile" cyanobacteria into scums that accumulate in one section of the pond. If a fall bloom occurs, please collect a sample in any clean jar or bottle and contact the VLAP Coordinator.

➤ **Secchi Disk Transparency**

Volunteer monitors use the Secchi disk, a 20 cm disk with alternating black and white quadrants, to measure how far a person can see into the water. Transparency, a measure of water clarity, can be affected by the amount of algae and sediment in the water, as well as the natural color of the water. Table 14 in Appendix A lists the current year transparency data. **The median summer transparency for New Hampshire's lakes and ponds is 3.2 meters.**

Figure 2 depicts the historical and current year transparency **with and without** the use of a viewscope.

STATION 1

The current year **non-viewscope** in-lake transparency was **3.5 meters in July**. The transparency cannot be correlated with chlorophyll-a concentrations as it was not measured regularly throughout the season.

The viewscope in-lake transparency was **greater than** the non-viewscope transparency on the **7/2/2009** sampling event. The transparency was **not** measured with the viewscope regularly throughout the season. A comparison of transparency readings taken with and without the use of a viewscope shows that the viewscope typically increases the depth to which the Secchi disk can be

seen into the lake, particularly on sunny and windy days. We recommend that your group measure Secchi disk transparency with and without the viewscope on each sampling event.

It is important to note that viewscope transparency data are not compared to a New Hampshire median or similar lake median. This is because lake transparency with the use of a viewscope has not been historically measured by DES. In the future, the New Hampshire and similar lake medians for viewscope transparency will be calculated and added to the appropriate graphs.

The historical data (the bottom graph) show that the **2009** mean non-viewscope transparency is ***slightly greater than*** the NH state median and ***less than*** the similar lake medians. Please refer to Appendix D for more information about the similar lake median.

Visual inspection of the historical data trend line (the bottom graph) shows a ***decreasing*** trend, meaning that the transparency has ***worsened*** since monitoring began in **1988**.

STATION 2

The current year ***non-viewscope*** in-lake transparency was **3.0 meters in July**. The transparency cannot be correlated with chlorophyll-a concentrations as it was not measured regularly throughout the season.

The viewscope in-lake transparency was ***greater than*** the non-viewscope transparency on the **7/2/2009** sampling event. The transparency was ***not*** measured with the viewscope regularly throughout the season. As discussed previously, a comparison of transparency readings taken with and without the use of a viewscope shows that the viewscope typically increases the depth to which the Secchi disk can be seen into the lake, particularly on sunny and windy days. We recommend that your group measure Secchi disk transparency with and without the viewscope on each sampling event.

It is important to note that viewscope transparency data are not compared to a New Hampshire median or similar lake median. This is because lake transparency with the use of a viewscope has not been historically measured by DES. In the future, the New Hampshire and similar lake medians for viewscope transparency will be calculated and added to the appropriate graphs.

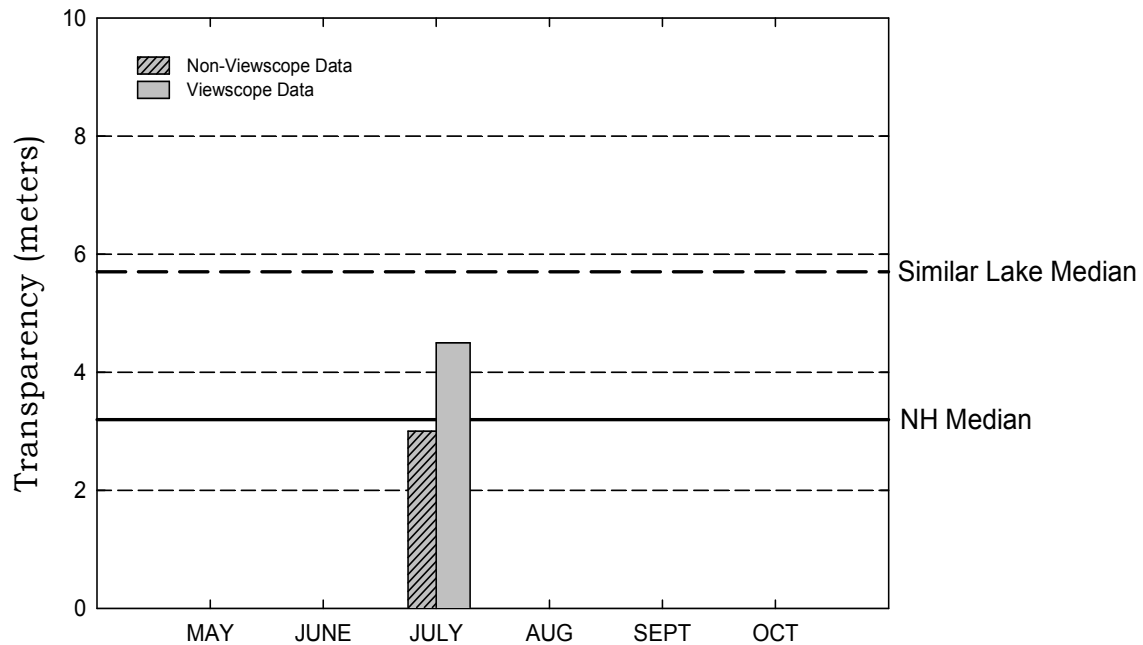
The historical data (the bottom graph) show that the **2009** mean non-viewscope transparency is ***slightly less than*** the state median and ***less than*** the similar lake median. Please refer to Appendix D for more information about the similar lake median.

Visual inspection of the historical data trend line (the bottom graph) shows a ***decreasing*** trend, meaning that the transparency has ***worsened*** since monitoring began in **1988**.

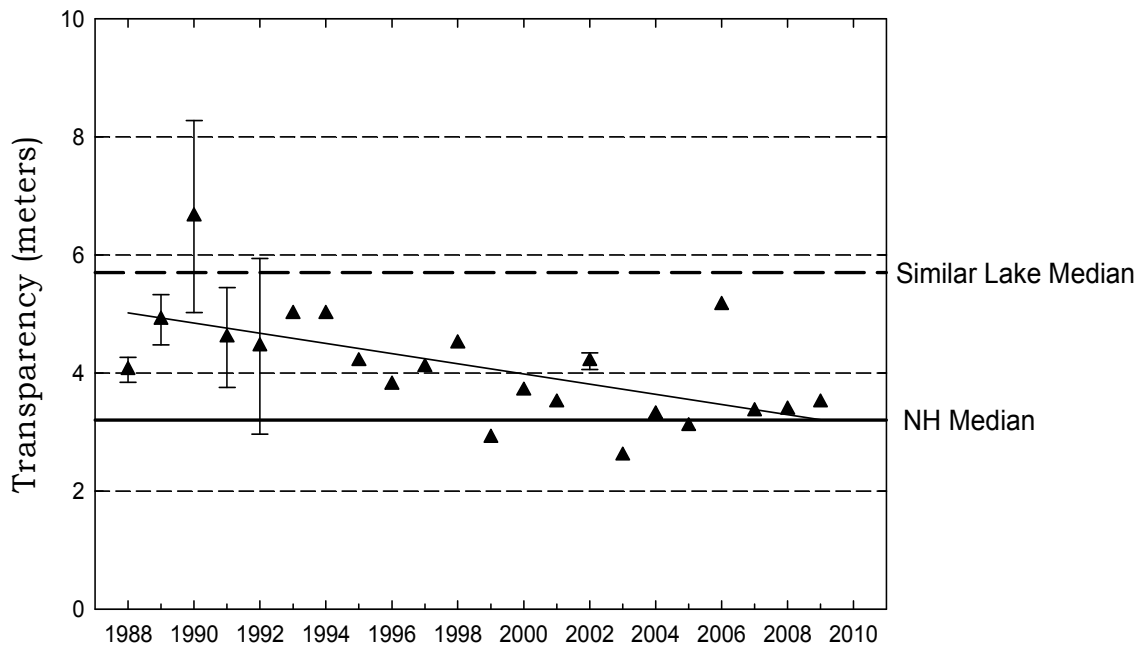
Typically, high intensity rainfall causes sediment-laden stormwater runoff to flow into surface waters, thus increasing turbidity and decreasing clarity. Efforts should continually be made to stabilize stream banks, pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the pond. Guides to best management practices that can be implemented to reduce, and possibly even eliminate, nonpoint source pollutants, are available from DES upon request.

Cobbetts Pond, Stn.1, Windham

Figure 2. Monthly and Historical Transparency Results



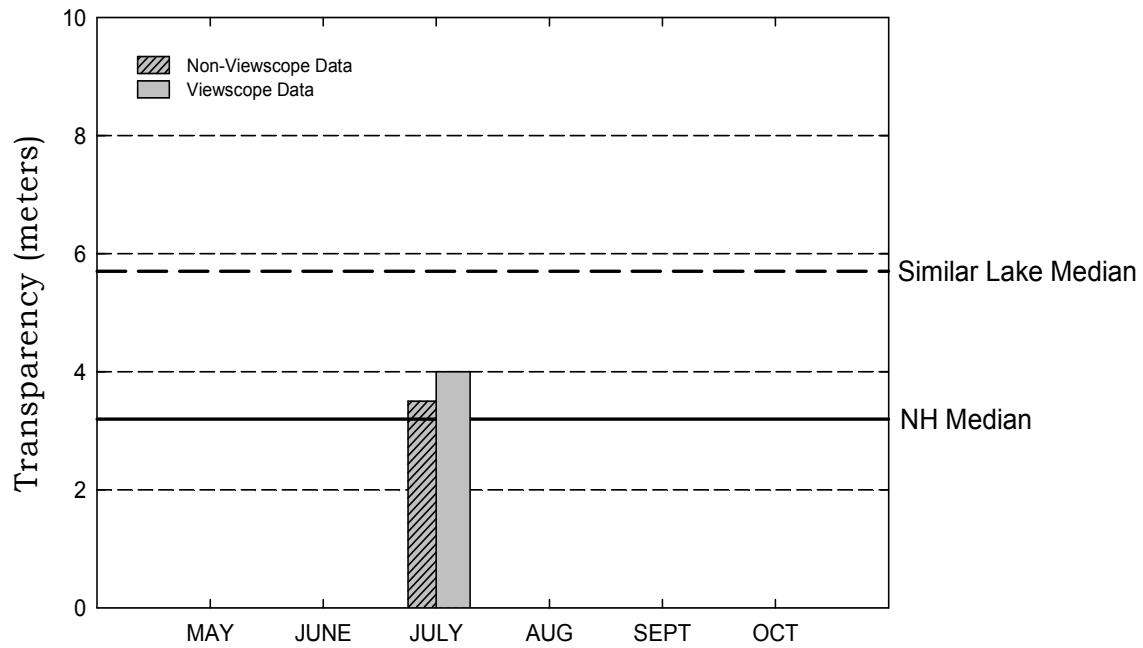
2009 Transparency Viewscope and Non-Viewscope Results



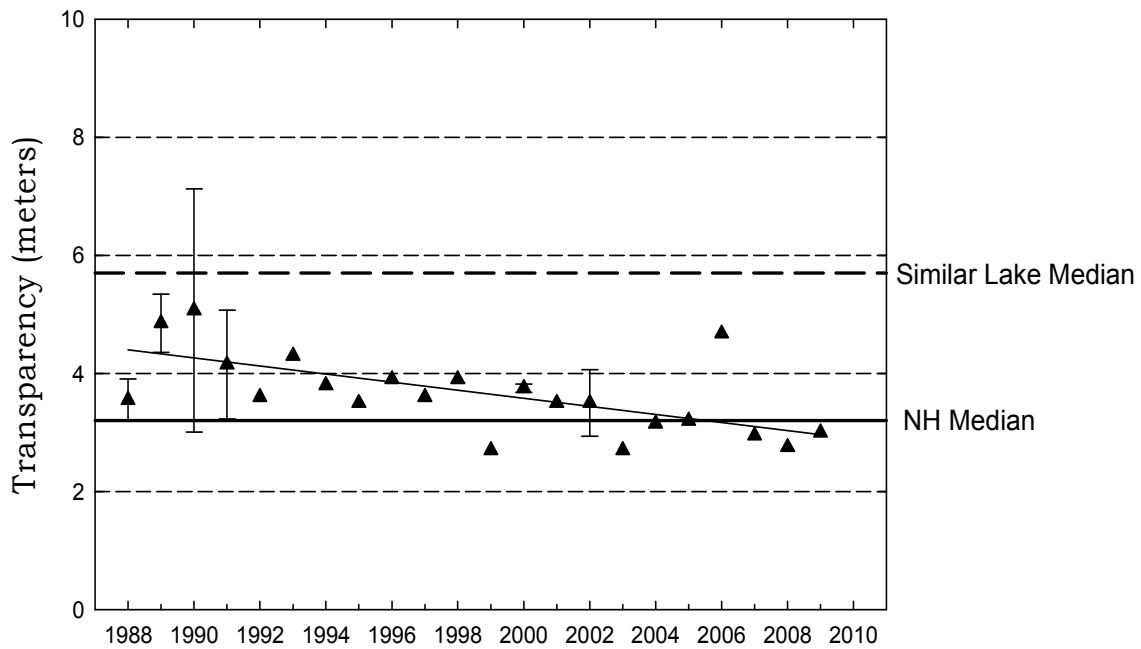
Historical Transparency Non-Viewscope Results

Cobbetts Pond, Stn.2, Windham

Figure 2. Monthly and Historical Transparency Results



2009 Transparency Viewscape and Non-Viewscope Results



Historical Transparency Non-Viewscope Results

➤ Total Phosphorus

Phosphorus is typically the limiting nutrient for vascular plant and algae growth in New Hampshire's lakes and ponds. Excessive phosphorus in a pond can lead to increased plant and algal growth over time. Table 14 in Appendix A lists the current year total phosphorus data for in-lake and tributary stations.

The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 12 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.

The graphs in Figure 3 depict the historical amount of epilimnetic (upper layer) and hypolimnetic (lower layer) total phosphorus concentrations; the inset graphs depict current year total phosphorus data.

STATION 1

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration ***remained stable*** from **May** to **June**, ***decreased slightly*** from **June** to **July**, ***increased slightly*** from **July** to **August**, ***decreased slightly*** from **August** to **September**, and then ***increased greatly*** from **September** to **October**.

The large increase in epilimnetic total phosphorus on the October sampling event was likely a result of "lake turnover". When lakes and ponds turnover in the fall, the phosphorus rich hypolimnetic waters are re-circulated throughout the water column causing a temporary increase in epilimnetic phosphorus concentrations.

The historical data show that the **2009** mean epilimnetic phosphorus concentration is ***greater than*** the state and similar lake medians. Refer to Appendix D for more information about the similar lake median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration ***decreased drastically*** from **May** to **June**, ***increased gradually*** from **June** to **August**, ***remained stable*** from **August** to **September**, and then ***decreased*** from **September** to **October**.

The hypolimnetic (lower layer) phosphorus samples were generally ***elevated*** throughout the season, particularly in May. These data suggest that the process of ***internal phosphorus loading*** is occurring in the pond. When the hypolimnetic dissolved oxygen concentration is depleted to less than 1 mg/L, the phosphorus that is normally bound up with metals in the sediment may be re-released into the water column. Since an internal source of phosphorus in the pond may be present, it is even more important that watershed residents act proactively to minimize phosphorus loading from the watershed.

The historical data show that the **2009** mean hypolimnetic phosphorus concentration is ***much greater than*** the state and similar lake medians. Please refer to Appendix D for more information about the similar lake median.

Overall, visual inspection of the epilimnetic and hypolimnetic historical data trend lines shows an ***increasing*** phosphorus trend since monitoring began. Specifically the mean annual epilimnetic and hypolimnetic phosphorus concentration has ***worsened*** since monitoring began in **1988**.

STATION 2

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration ***decreased*** from **May** to **June**, ***increased gradually*** from **June** to **August**, and then ***decreased gradually*** from **August** to **October**.

The historical data show that the **2009** mean epilimnetic phosphorus concentration is ***slightly greater than*** the state and similar lake medians. Refer to Appendix D for more information about the similar lake median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration ***decreased*** from **May** to **June**, ***increased*** from **June** to **July**, ***increased greatly*** from **July** to **August**, ***increased again*** from **August** to **September**, and then ***decreased greatly*** from **September** to **October**.

The hypolimnetic (lower layer) phosphorus concentrations were **110 and 130 ug/L** on the **August** and **September** sampling events. These data suggest that the process of ***internal phosphorus loading*** is occurring in the pond. When the hypolimnetic dissolved oxygen concentration is depleted to less than 1 mg/L, the phosphorus that is normally bound up with metals in the sediment may be re-released into the water column. Since an internal source of phosphorus in the pond may be present, it is even more important that watershed residents act proactively to minimize phosphorus loading from the watershed.

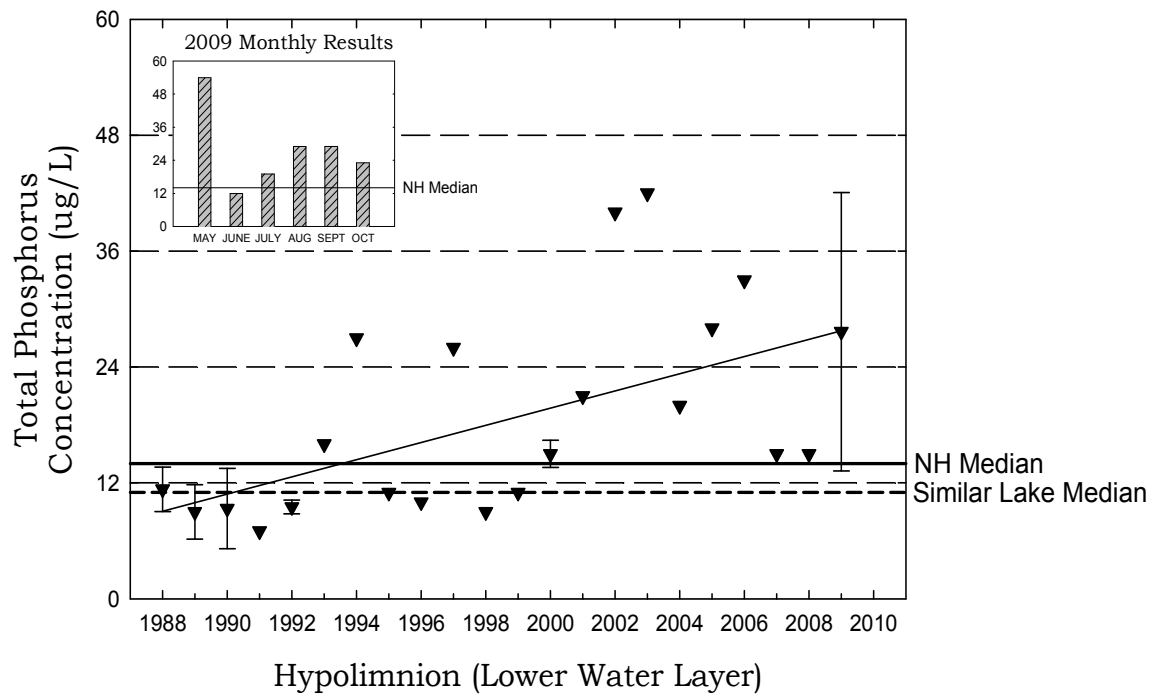
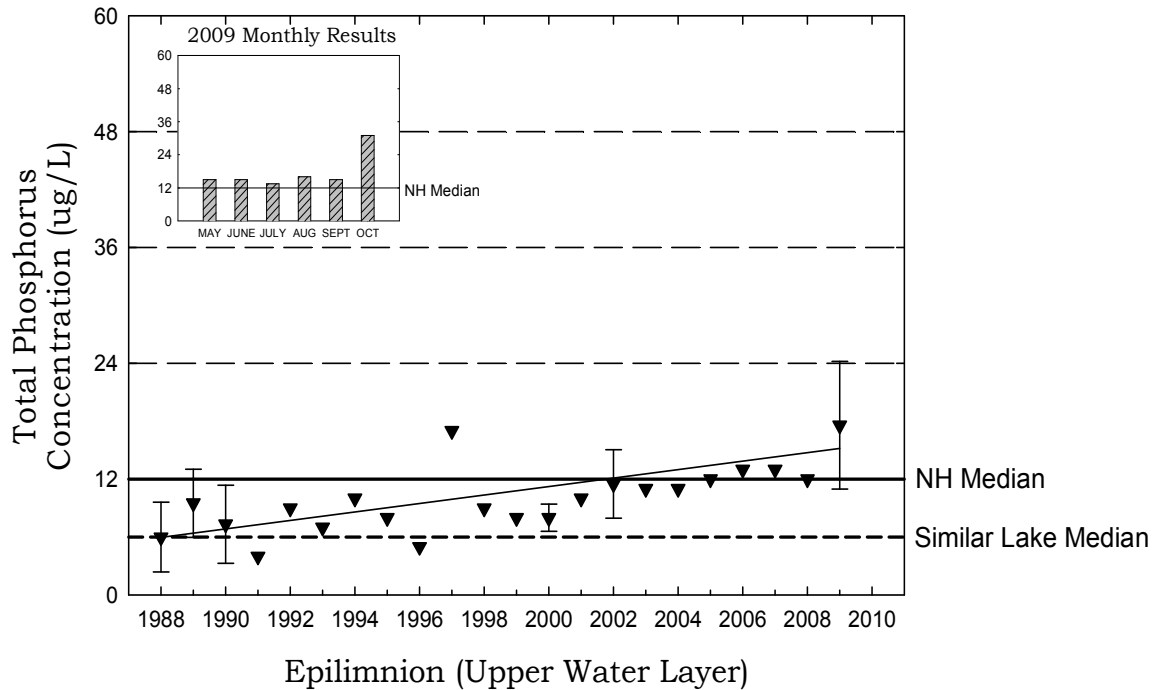
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Overall, visual inspection of the epilimnetic and hypolimnetic historical data trend lines shows an ***increasing*** phosphorus trend since monitoring began. Specifically the mean annual epilimnetic and hypolimnetic phosphorus concentration has ***worsened*** since monitoring began in **1988**.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about the watershed sources of phosphorus and how excessive phosphorus loading can negatively affect the ecology and the recreational, economical, and ecological value of lakes and ponds.

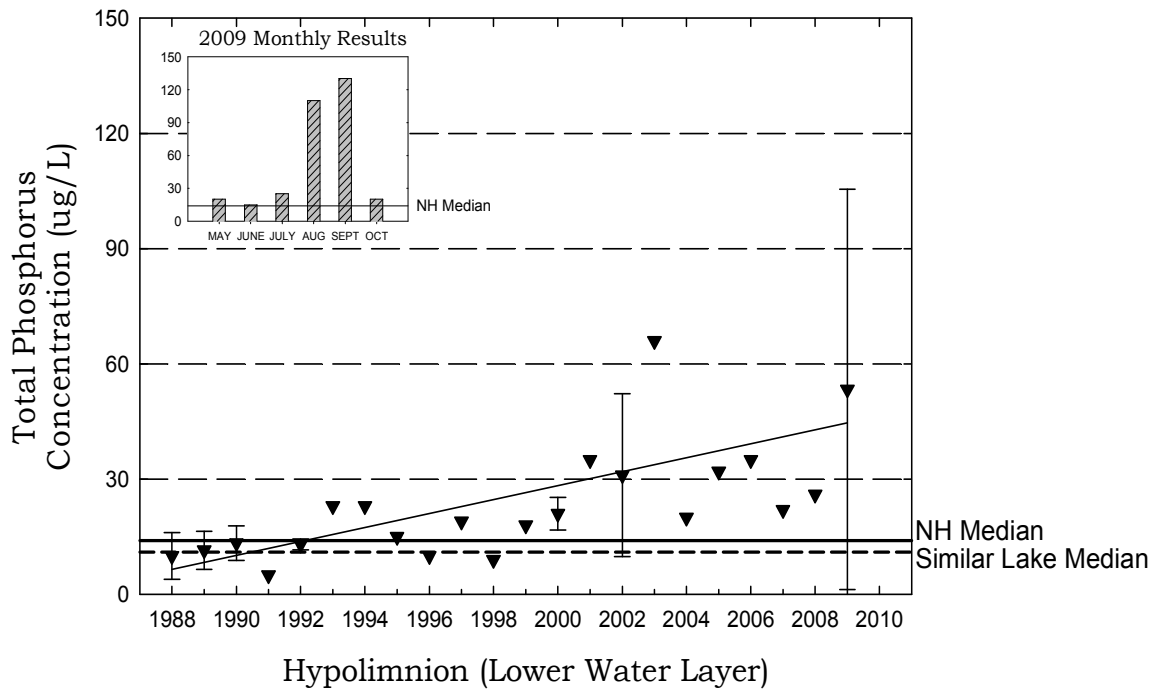
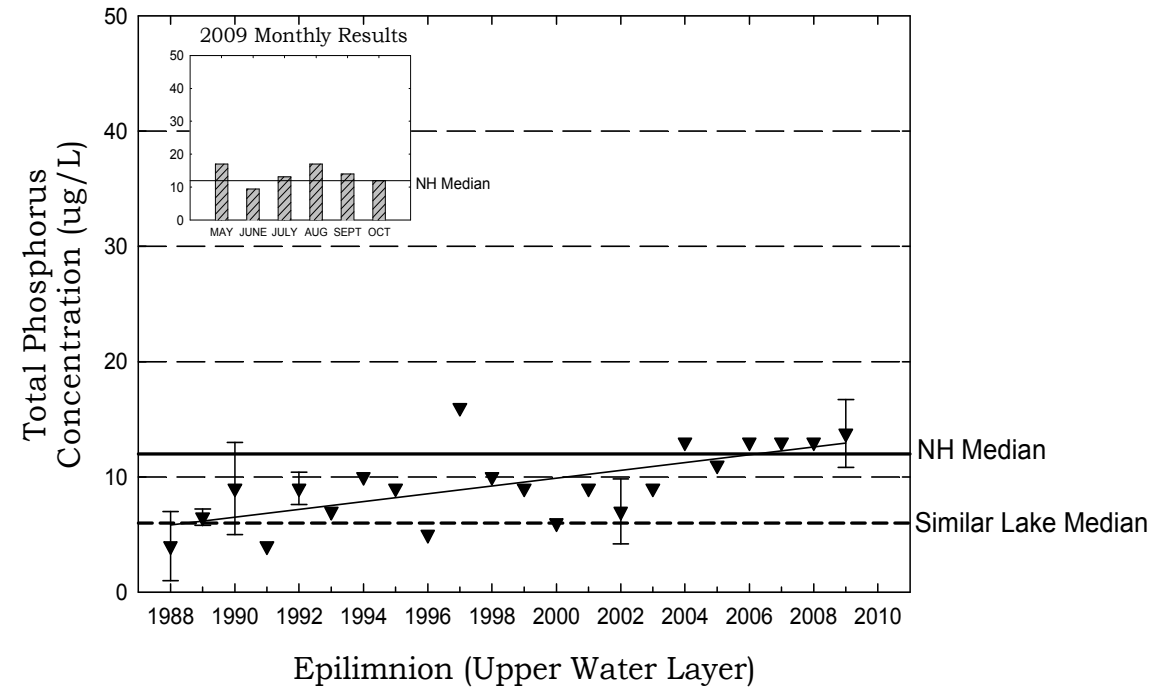
Cobbetts Pond, Stn. 1, Windham

Figure 3. Monthly and Historical Total Phosphorus Data



Cobbetts Pond, Stn. 2, Windham

Figure 3. Monthly and Historical Total Phosphorus Data



➤ pH

Table 14 in Appendix A presents the current year pH data for the in-lake stations.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 6.0 typically limits the growth and reproduction of fish. A pH between 6.0 and 7.0 is ideal for fish. The median pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.6**, which indicates that the state surface waters are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

The pH at the deep spots this year ranged from **6.98** to **7.06** in the epilimnions and from **6.62** to **6.77** in the hypolimnions, which means that the epilimnions are ***approximately neutral***, and the hypolimnions are ***slightly acidic***.

It is important to point out that the hypolimnetic (lower layer) pH was ***lower (more acidic)*** than in the epilimnion (upper layer). This increase in acidity near the bottom is likely due to the decomposition of organic matter and the release of acidic by-products into the water column.

Due to the state's abundance of granite bedrock and acid deposition received from snowmelt, rainfall, and atmospheric particulates, there is little that can be feasibly done to effectively increase pond pH. The pH at the deep spot, however, is sufficient to support aquatic life.

➤ Acid Neutralizing Capacity (ANC)

Table 14 in Appendix A presents the current year epilimnetic ANC for the deep spot.

Buffering capacity (ANC) describes the ability of a solution to resist changes in pH by neutralizing the acidic input. The median ANC value for New Hampshire's lakes and ponds is **4.9 mg/L**, which indicates that many lakes and ponds in the state are at least "moderately vulnerable" to acidic inputs. For a more detailed explanation about ANC, please refer to the "Chemical Monitoring Parameters" section of this report.

The acid neutralizing capacity (ANC) of the epilimnions (upper layer) ranged from **23.2 mg/L to 23.5 mg/L**. This indicates that the pond has a ***low vulnerability*** to acidic inputs.

➤ Conductivity

Table 14 in Appendix A presents the current conductivity data for in-lake

stations.

Conductivity is the numerical expression of the ability of water to carry an electric current, which is determined by the number of negatively charged ions from metals, salts, and minerals in the water column. The median conductivity value for New Hampshire's lakes and ponds is **40.0 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The conductivity has **increased** in the pond since monitoring began. In addition, the in-lake conductivity is **much greater than** the state median. Typically, increasing conductivity indicates the influence of pollutant sources associated with human activities. These sources include failed or marginally functioning septic systems, agricultural runoff, and road runoff which contains road salt during the spring snow-melt. New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could also contribute to increasing conductivity. In addition, natural sources, such as iron and manganese deposits in bedrock, can influence conductivity.

It is likely that de-icing materials applied to nearby roadways, and more recently construction activities, during the winter months may be influencing the conductivity in the pond. In New Hampshire, the most commonly used de-icing material is salt (sodium chloride).

*A limited amount of chloride sampling was conducted during **2009**. Please refer to the chloride discussion for more information.*

Therefore, we recommend that the **epilimnion** (upper layer) be sampled for chloride next year. This additional sampling may help us identify what areas of the watershed are contributing to the increasing in-lake conductivity.

Please note that the DES Limnology Center in Concord is able to conduct chloride analyses, free of charge. As a reminder, it is best to conduct chloride sampling in the spring as the snow is melting and during rain events.

➤ **Dissolved Oxygen and Temperature**

Table 9 in Appendix A depicts the dissolved oxygen/temperature profile(s) collected during **2009**.

The presence of sufficient amounts of dissolved oxygen in the water column is vital to fish and amphibians and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

STATIONS 1 AND 2

During this year, and many past sampling years, the pond has experienced a lower dissolved oxygen concentration and higher total phosphorus concentration in the hypolimnion (lower layer) than in the epilimnion (upper

layer). These data suggest that the process of ***internal phosphorus loading*** is occurring in the pond. When the hypolimnetic dissolved oxygen concentration is depleted to less than 1 mg/L, **as it was on the annual biologist visit this year and on many previous annual visits**, the phosphorus that is normally bound up with metals in the sediment may be re-released into the water column. Since an internal source of phosphorus in the pond may be present, it is even more important that watershed residents act proactively to minimize phosphorus loading from the watershed.

The ***low*** hypolimnetic oxygen level is a sign of the pond's ***aging*** and ***declining*** health. This year the DES biologist conducted the dissolved oxygen profile in **July**. We recommend that the annual biologist visit for the **2010** sampling year be scheduled during **August** so that we can determine if oxygen is depleted in the hypolimnion ***later*** in the sampling year.

➤ **Turbidity**

Table 14 in Appendix A presents the current year data for in-lake turbidity.

Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the "Other Monitoring Parameters" section of this report for a more detailed explanation.

The turbidity of the epilimnion (upper layer) samples was ***slightly elevated (1.05 and 1.37 NTUs)*** on the **July** sampling event.

The abnormally wet conditions this summer likely led to increased stormwater runoff entering the pond. Stormwater runoff can carry particulate matter and deposits it in the pond causing turbid conditions. Or, an algal bloom had occurred in the pond.

The turbidity of the metalimnion (middle layer) samples was ***slightly elevated (2.61 and 2.64 NTUs)*** on the **July** sampling event. This suggests that a layer of algae or cyanobacteria may have been present at this location. Algae and cyanobacteria are often found in the metalimnion of ponds due to the differences in density between the epilimnion and the hypolimnion and the resulting abundance of food in that layer.

The hypolimnetic (lower layer) turbidity was ***slightly elevated (1.51 and 2.23 NTUs)*** on the **July** sampling event. In addition, the hypolimnetic turbidity has been elevated on many sampling events during previous sampling years. This suggests that the pond bottom may have been disturbed by the anchor or by the Kemmerer Bottle while sampling and/or that the lake bottom is covered by an easily disturbed thick organic layer of sediment. When the pond bottom is disturbed, phosphorus rich sediment is released into the water column. When collecting the hypolimnion sample, make sure that there is no sediment in the Kemmerer Bottle before filling the sample bottles.

TRIBUTARY SAMPLING

➤ **Total Phosphorus**

Table 14 in Appendix A presents the current year total phosphorus data for tributary stations. Please refer to the “Chemical Monitoring Parameters” section of the report for a detailed explanation of total phosphorus.

The phosphorus concentrations in the **Bella Vista, Castleton Culvert, Connie’s Brook, Dinsmore Bridge, Fossa Rd. Inlet, Mueller Stream, and Town Beach** samples on the **7/2/2009** sampling event were **elevated (400, 85, 50, 140, 38, 80, and 59 ug/L)**, and the turbidities were also **elevated (52.3, 24.3, 7.0, 51.5, 3.88, 13.3, and 7.37 NTUs)**. It had rained approximately **3.0 - 4.0 inches** during the **24-72 hours** prior to the **7/2/2009** sampling event. Rain events typically carry phosphorus laden watershed runoff and sediment loading to tributaries. Phosphorus sources in the watershed can include agricultural runoff, failing or marginal septic systems, stormwater runoff, road runoff, and watershed development.

Record summer rainfall likely increased stormwater runoff and nutrient loading to all tributaries, and specifically the source tributary from the I93, Exit 3 construction. As impervious surface cover increases in the watershed, stormwater runoff volumes increase. This transports phosphorus-laden stormwater into tributaries and eventually the pond. Efforts should be made in the watershed to reduce impervious surfaces and limit phosphorus sources such as fertilizer use, septic influences, agricultural impacts, and sediment/erosion control.

➤ **pH**

Table 14 in Appendix A presents the current year pH data for the tributary stations. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation of pH.

The pH of the tributary stations ranged from **6.68 to 7.14 (> 6)** and is sufficient to support aquatic life.

➤ **Conductivity**

Table 14 in Appendix A presents the current conductivity data for the tributary stations. Please refer to the “Chemical Monitoring Parameters” section of the report for a more detailed explanation of conductivity.

The **tributaries** have experienced elevated or fluctuating conductivity since monitoring began. We recommend that your monitoring group conduct a conductivity survey of tributaries with **elevated** conductivity and along the

shoreline of the pond to help identify the sources of conductivity. As previously mentioned increasing conductivity typically indicates the influence of pollutant sources associated with human activities.

For a detailed explanation on how to conduct rain event sampling and stream surveys, please refer to the 2002 VLAP Annual Report special topic article, which is posted on the VLAP website at

<http://www.des.nh.gov/organization/divisions/water/wmb/vlap/categories/publications.htm>, or contact the VLAP Coordinator.

It is likely that de-icing materials applied to nearby roadways during the winter months may be influencing the conductivity in the tributaries. In New Hampshire, the most commonly used de-icing material is salt (sodium chloride).

*A limited amount of chloride sampling was conducted during **2009**. Please refer to the chloride discussion for more information.*

Therefore, we recommend that the **tributaries** be sampled for chloride next year. This additional sampling may help us identify what areas of the watershed are contributing to the increasing in-lake conductivity.

Please note that the DES Limnology Center in Concord is able to conduct chloride analyses, free of charge. As a reminder, it is best to conduct chloride sampling in the spring as the snow is melting and during rain events.

➤ **Turbidity**

Table 14 in Appendix A presents the current year turbidity data for the tributary stations. Please refer to the “Other Monitoring Parameters” section of the report for a more detailed explanation of turbidity.

The **tributaries** experienced turbid conditions on **7/2/2009**, the result of stormwater runoff from significant rain events prior to sampling. Rainfall creates runoff that washes sediment and organic materials into tributaries causing turbid water conditions. Eventually, the suspended solids settle out once the flow is reduced or the tributary flow enters the lake.

➤ **Bacteria (*E. coli*)**

Table 14 in Appendix A lists the current year data for bacteria (*E.coli*) testing. *E. coli* is a normal bacterium found in the large intestine of humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured and its presence in the water, in defined amounts, indicates that sewage **may** be present. If sewage is present in the water, potentially harmful disease-causing organisms **may** also be present. Please refer to the “Other Monitoring Parameters” section of the report for a more detailed explanation.

The **Community Beach and Town Beach** *E. coli* concentrations were **elevated** on the **7/2/2009** sampling event. Specifically, the results of **250** counts per 100 mL and **TNTC** (too numerous to count) **were greater than** the state standard of 88 counts per 100 mL for designated public beaches.

These samples were collected immediately following a rain event, and indicate that stormwater runoff carries *E. coli* and other pollutants to the beach areas. We recommend that your group continue *E. coli* sampling at these stations next year, before, during and after rain events. If this trend continues, a pre-emptive bacteria advisory may be warranted after specific rainfall amounts. This additional sampling may help us determine the source of the bacteria.

For a detailed explanation on how to conduct rain event sampling and stream surveys, please refer to the 2002 VLAP Annual Report special topic article, which is posted on the VLAP website at <http://www.des.nh.gov/organization/divisions/water/wmb/vlap/categories/publications.htm>, or contact the VLAP Coordinator.

➤ Chlorides

Table 14 in Appendix A lists the current year data for chloride sampling. The chloride ion (Cl⁻) is found naturally in some surface waters and groundwaters and in high concentrations in seawater. Research has shown that elevated chloride levels can be toxic to freshwater aquatic life. In order to protect freshwater aquatic life in New Hampshire, the state has adopted **acute and chronic** chloride criteria of **860 and 230 mg/L** respectively. The chloride content in New Hampshire lakes is naturally low, generally less than 2 mg/L in surface waters located in remote areas away from habitation. Higher values are generally associated with salted highways and, to a lesser extent, with septic inputs. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

Connie’s Brook was sampled for chloride from **February** through **April**. The results were **76, 90, 69, 68, and 82 mg/L**, which are ***much less than*** the state acute chloride criteria, and only ***slightly less than*** the state chronic chloride criteria.

Connie’s Brook at Rt. 111 was sampled for chloride from **February** through **March**. The results were **53, 55, and 37 mg/L**, which are ***much less than*** the state acute chloride criteria, and ***less than*** the state chronic chloride criteria.

We recommend that your monitoring group continue to conduct chloride sampling at the deep spot and tributaries, particularly in the spring during snow-melt and rain events during the summer. This will establish a baseline of data that will assist your monitoring group and DES to determine lake quality trends in the future.

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Please note that chloride analyses can be run free of charge at the DES Limnology Center. Please contact the VLAP Coordinator if you are interested in chloride monitoring.

DATA QUALITY ASSURANCE AND CONTROL

Annual Assessment Audit

During the annual visit to your pond, the biologist conducted a sampling procedures assessment audit for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled-out an assessment audit sheet to document the volunteer monitors' ability to follow the proper field sampling procedures, as outlined in the VLAP Monitor's Field Manual. This assessment is used to identify any aspects of sample collection in which volunteer monitors failed to follow proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an **excellent** job collecting samples on the annual biologist visit this year! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the biologist to provide additional training. Keep up the good work!

USEFUL RESOURCES

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, DES Booklet WD-03-42, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-03-42.pdf.

Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, DES fact sheet WMB-10, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/wmb/documents/wmb-10.pdf.

Erosion Control for Construction in the Protected Shoreland Buffer Zone, DES fact sheet WD-SP-1, (603) 271-2975 or <http://des.nh.gov/organization/commissioner/pip/factsheets/sp/documents/sp-1.pdf>

How to Identify Cyanobacteria, DES Pamphlets & Brochures, (603) 271-2975 or http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/cyano_id_flyer.pdf

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, DES fact sheet WD-BB-9, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/bb/documents/bb-9.pdf.

Low Impact Development Hydrologic Analysis. Manual prepared by Prince George's County, Maryland, Department of Environmental Resources. July 1999. To access this document, visit www.epa.gov/owow/nps/lid_hydr.pdf or call the EPA Water Resource Center at (202) 566-1736.

Low Impact Development: Taking Steps to Protect New Hampshire's Surface Waters, DES fact sheet WD-WMB-17, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/wmb/documents/wmb-17.pdf.

NH Stormwater Management Manual Volume 1: Stormwater and Antidegradation, DES fact sheet WD-08-20A, (603) 271-2975 or <http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-08-20a.pdf>

NH Stormwater Management Manual Volume 2: Post-Construction Best Management Practices Selection and Design, DES fact sheet WD-08-20B, (603) 271-2975 or <http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-08-20b.pdf>

NH Stormwater Management Manual Volume 3: Erosion and Sediment Controls During Construction, DES fact sheet WD-08-20C, (603) 271-2975 or

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<http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-08-20c.pdf>

Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act, DES fact sheet WD-SP-2, (603) 271-2975 or <http://des.nh.gov/organization/commissioner/pip/factsheets/sp/documents/sp-2.pdf>.

Road Salt and Water Quality, DES fact sheet WD-WMB-4, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/wmb/documents/wmb-4.pdf.

Sand Dumping - Beach Construction, DES fact sheet WD-BB-15, (603) 271-2975 or <http://des.nh.gov/organization/commissioner/pip/factsheets/bb/documents/bb-15.pdf>.

Shorelands Under the Jurisdiction of the Comprehensive Shoreland Protection Act, DES fact sheet SP-4, (603) 271-2975 or <http://des.nh.gov/organization/commissioner/pip/factsheets/sp/documents/sp-4.pdf>.

Through the Looking Glass: A Field Guide to Aquatic Plants, North American Lake Management Society, 1988, (608) 233-2836 or www.nalms.org.

Vegetation Maintenance Within the Protected Shoreland, DES fact sheet WD-SP-5, (603) 271-2975 or <http://des.nh.gov/organization/commissioner/pip/factsheets/sp/documents/sp-5.pdf>

Watershed Districts and Ordinances, DES fact sheet WD-WMB-16, (603) 271-2975 or www.des.nh.gov/organization/commissioner/pip/factsheets/wmb/documents/wmb-16.pdf.